A PRELIMINARY ENVIRONMENTAL PROFILE OF CALIFORNIA'S IMPORTED ELECTRICITY

Prepared in Support of the 2005 Electricity Environmental Performance Report

California Energy Commission Staff
Aspen Environmental Group
June 27, 2005

Why Develop An Environmental Report on Out of State Power?

- Knowledge Gap for In-State and Out-of-State Environmental Performance
- California's Electricity System Increasingly Integrated into WECC

  "Island Mentality" no longer appropriate
- Increasing Concern Over Climate Change and California Sources of Greenhouse Gas Emissions

Report Purpose

- Develop Preliminary, Screening Scale Environmental Profile for California's Electricity Imports
  - Develop Information that Can Be Used by Energy Commission, Other Agencies, Stakeholders
- Identify Generation Sources and Trends
  - Dedicated Resources and General Imports
- Prepare as Information. No Staff Policy Options

Workshop Presentation

- Purpose and Intent of Out-of-State Power Report
- Findings
- Background on Imported Power and Dedicated Coal Plants
- Imported Power Effects on Aquatic Populations, Water Quality and Supply
  - Screening Level Overview
- Imported Power Effects on Air Quality
  - More Detailed Analysis

Overall Findings of Out-Of-State Power Report

- California Imports average 31% of Its Electricity
  - 9% comes from plants owned by CA utilities
  - Different accounting for supply-demand balance and environmental assessments
- Resource Mix Varies by Region
  - Hydropower dominates NW
  - Coal Dominates SW
- Coal an Important but Hidden Part of California's Electricity Supply (4,744 MW of Dedicated Coal)
- Prior Trend for Gas-Fired Plants now Replaced by Surge of New Coal Plants

Overall Findings Cont.

- 27 New Coal Plants (15,900 MW); Most Use Pulverized Coal Combustion (PCC) Technology
- Out-of-State Air Emissions Higher than In-State Generation; Driven by Coal
- Water Use a Key Environmental Issue for Power Generation in the West
- Hydropower Impacts to Fisheries Continue
- Renewable Import Levels May Grow as CA Utilities Demand More

Power Imports to California

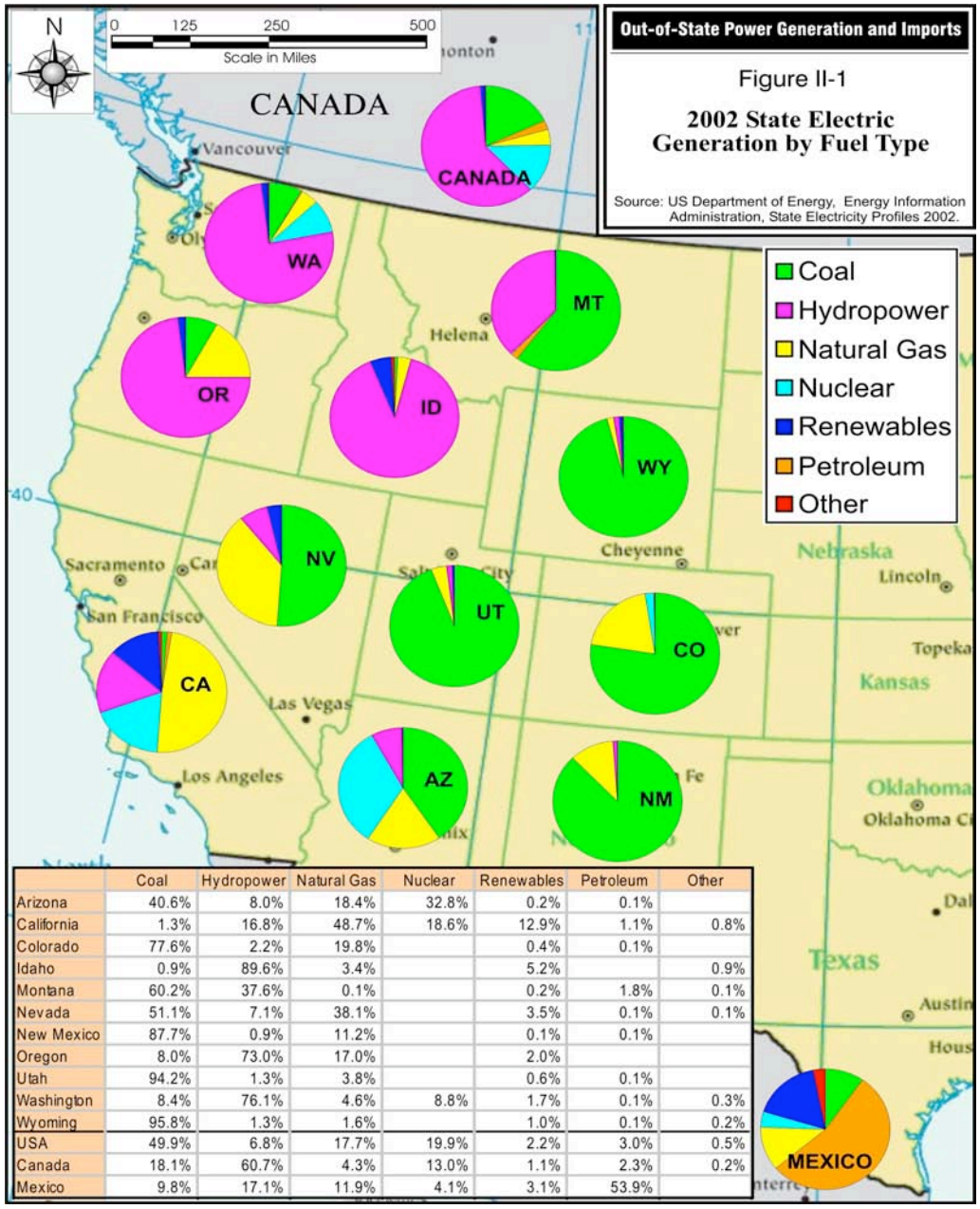
- California Imported 31% of Annual Electricity (averaged over 2001-2003).
- Sources Include: Coal, Hydropower, Natural Gas, Nuclear, Wind, Geothermal, Biomass
- These Sources Vary by Region, State
- Imports from Canada and Mexico As Well
- In 2003, 36% imported power from NW and 64% from SW

Import Generation Will Vary

- Weather, Other Factors Determine Imports
- 2002 Capacity and Generation as follows:

Coal	31,857 MW	35%
Hydro	56,156 MW	27%
Natural Gas	39,119 MW	22%
Nuclear	9,165 MW	11%,
Renewables	6,471 MW	4.5%

- Dedicated Coal Imports (4,744 MW) More Constant



	Coal	Hydropower	Natural Gas	Nuclear	Renewables	Petroleum	Other
Arizona	40.6%	8.0%	18.4%	32.8%	0.2%	0.1%	
California	1.3%	16.8%	48.7%	18.6%	12.9%	1.1%	0.8%
Colorado	77.6%	2.2%	19.8%		0.4%	0.1%	
Idaho	0.9%	89.6%	3.4%		5.2%		0.9%
Montana	60.2%	37.6%	0.1%		0.2%	1.8%	0.1%
Nevada	51.1%	7.1%	38.1%		3.5%	0.1%	0.1%
New Mexico	87.7%	0.9%	11.2%		0.1%	0.1%	
Oregon	8.0%	73.0%	17.0%		2.0%		
Utah	94.2%	1.3%	3.8%		0.6%	0.1%	
Washington	8.4%	76.1%	4.6%	8.8%	1.7%	0.1%	0.3%
Wyoming	95.8%	1.3%	1.6%		1.0%	0.1%	0.2%
USA	49.9%	6.8%	17.7%	19.9%	2.2%	3.0%	0.5%
Canada	18.1%	60.7%	4.3%	13.0%	1.1%	2.3%	0.2%
Mexico	9.8%	17.1%	11.9%	4.1%	3.1%	53.9%	

Dedicated Coal Plant Ownership

Navajo Generating Station (2,409 MW)	LADWP	21.2%
Reid Gardner Generating Plant (612 MW)	DWR	67.85
Mohave Generating Station (1,636 MW)	LADWP SCE	10% 56%
Four Corners Power Plant (2,070 MW)	SCE	48%
San Juan Generating Station (1,848 MW)	So. Cal cities IID MSR Public Power	31.5% 21.3% 28.7%
Intermountain Power Plant (1,640 MW)	CA companies with entitlement	96%

Dedicated Coal Plant Locations

1. **Mohave Generating Station**
   Laughlin, NV;
   (1,580 MW)
2. **Reid Gardner Generating Plant**
   Moapa, NV;
   (556 MW)
3. **Intermountain Power Plant**
   Delta, UT;
   (1,640 MW)
4. **Navajo Generating Station**
   Page, AZ;
   (2,250 MW)
5. **San Juan Generating Station**
   Waterflow, NM;
   (1,643 MW)
6. **Four Corners Power Plant**
   Farmington, NM;
   (2,040 MW)

Coal Power Imports Could Increase

- 27 Plants (~ 16,000 MW) in Western States are Proposed, Have Received Permits or Under Construction
- 10 are in NW; 17 are in SW
- Four-state 1,300 mile Frontier Line Proposed
- Growth in Coal Plants May Displace Previous Growth in Natural Gas Plants

New Coal Plants May Use Advanced Technologies

Coal Technologies	Current Use in West	Proposed Use in West
Pulverized Coal Combustion (PCC)	All?	24 (1 with SCR)
Integrated Gasification Combined Cycle (IGCC)		1
Circulation Fluidized Bed Combustion		2
Pressurized PCC		
Supercritical and Ultrasupercritical		

Major Environmental Effects of Imported Power

- Air Emissions from Coal, Natural Gas (discussed in air quality presentation)
- Global Climate Change Emissions from Coal, Natural Gas (also discussed in air quality presentation)
- Aquatic Effects, Particularly from Hydropower
- Water Quality and Water Supply from Coal, Natural Gas, Nuclear Plants in SW

Aquatic Effects

- Impacts From Hydropower Dam Placement and Operation
  - Eliminate Habitat; Cause loss of biodiversity
  - Obstruct river flows
  - Alter Nutrient Cycles
  - Disrupt Temperature Regimes
  - Block Fish Migration
  - Cause Injury and Death to Fish Species

Mitigation of Impacts to Fisheries

- Significant Drops in Fish Populations Spurring Mitigation

  - Salmon/Steelhead returns on Columbia River have dropped from 16 million/yr to 1 million/yr
- Fish Passage Efficiency/Fish Survival Standards
- FERC Relicensing Opportunity for Mitigation of Some Hydro (BPA facilities not licensed by FERC)
- Mitigation Costs Have Led Some Operators to Apply for Decommissioning (e.g., Bull River, OR)
- 177 Dams Removed in U.S. Over Past Decade

Water Quality/Supply Effects

- Coal, Natural Gas, and Nuclear Plants Use Large Quantities of Water for Cooling
- Water Use Can Exacerbate Shortages; Increase Competition with Other Users
- Mitigation Includes Alternative Cooling Water Supplies, Dry-Cooling, Zero Liquid Discharge
- Effects to Gila River from Palo Verde Nuclear Generating Station Use of Treated Wastewater
- Mohave Plant Uses Coal Slurry (4,400 acre-feet/yr from groundwater

IMPORTED ELECTRICITY

Air Quality Summary of Findings

1. **Imported power on average is higher polluting than in-state power**
2. **Imported power does not generally appear to substantially contribute to non-attainment area pollution**
3. **Imported power is not a major source of air toxic pollution or significant contributor to air toxic risk**
4. **Imported power sources, including dedicated coal plants, may be a significant contributor to specific Class 1 Area regional haze problems**

Air Quality Introduction

- Imports Primarily from Western States
- Some Imports from Canada and Mexico
- Southwest Power Primarily From Coal-Fired Plants
- California Utilities Own 4,744 MW of Coal-Fired Power
- Imports are ~¼ to ⅓ of Total Consumption
- Apportionment of Imports Difficult Since Deregulation
- Imports Will Increase in Future

Fuel/Technology Considerations

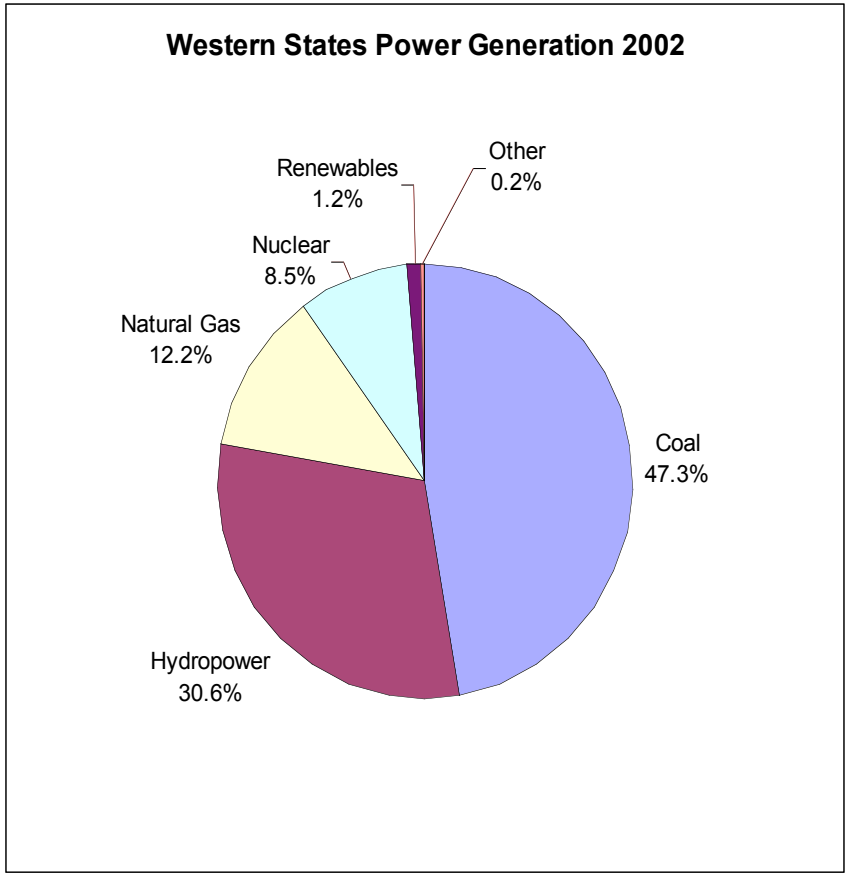
Fuels

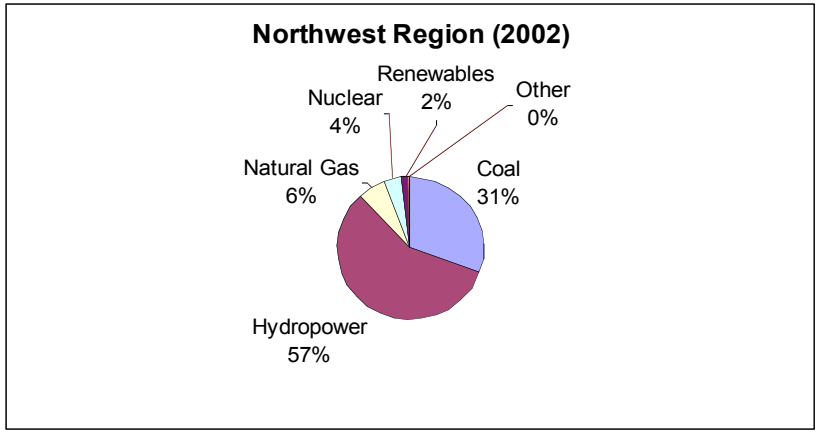
- Coal contains nitrogen, sulfur, and trace metals increasing NOx, SO2, and metals (mercury, lead, etc.) emissions
- Natural gas is a cleaner fuel with a lower carbon to btu ratio so it has lower baseline emissions including CO2 per Btu

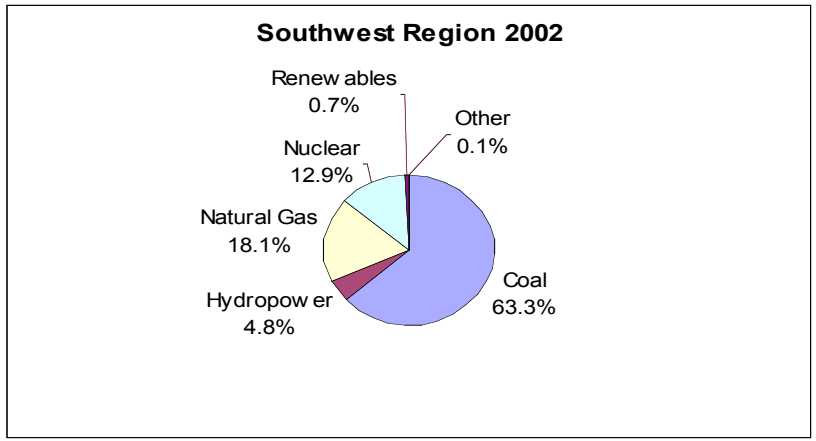
Technologies

- Non-combustion technologies generally have no direct criteria pollutant emissions (except cooling PM10)
- Boilers (coal or natural gas) are less efficient than combined cycle technologies (higher CO2 emission rates)
- Plant specific emissions, regardless of fuel or technology, are a function of the level pollution controls

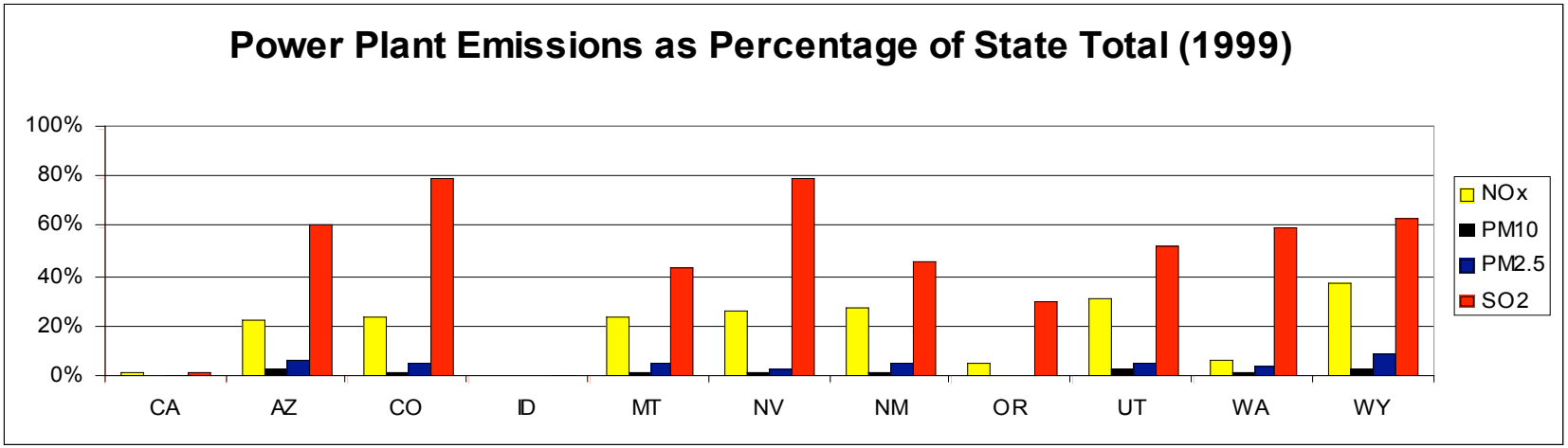
Western States Power







Power Plant Emissions by State



- Nitrogen Oxides (NOx) and Sulfur Dioxide (SO_2) emissions from power plants are significant portion of state totals for states with coal-fired generation
- PM10/PM2.5 emissions from power plants are small percentage of all western state totals

Air Quality Issues

Coal-Fired Power Plant Criteria Pollutant Emissions

Criteria Pollutant Emissions from Coal-Fired Power Plants are substantially greater than from other technologies or other fuels

Greenhouse Gas Emissions

Greenhouse gas emissions are on average higher from imported power

Regional Haze/Class 1 Area Impacts

There are 79 Class 1 Areas in the western states

Non-Attainment Areas

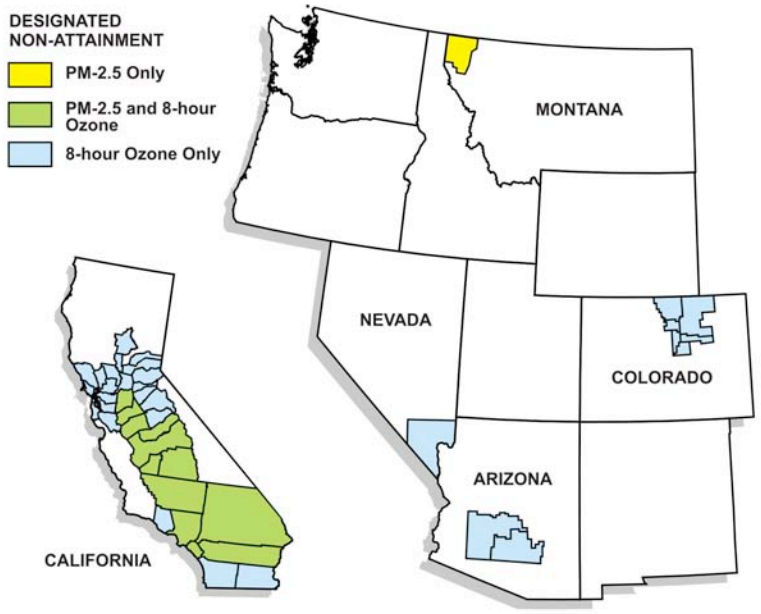
Power plant are not major contributors to western states non-attainment

Mercury Emissions

Power plants are not the major source of mercury emissions in west

Western States 8-Hour Ozone and PM2.5 Non-Attainment Areas

- All Western States 8-hour Ozone non-attainment areas are urban areas (Las Vegas, Phoenix, Denver)
- The only PM2.5 non-attainment area surrounds Libby MT, which does not have nearby large coal-fired power plants



Regulatory Issues

New Source Review (NSR)

Provisions of this rule, if not weakened, will ensure low emissions from new plants and emission reductions from modified plants

Clean Air Mercury Rule (CAMR)

Cap and trade rule will reduce mercury emissions 70% nationally

Clean Air Interstate Rule (CAIR)

Western states excluded from CAIR emission reduction requirements

Clear Skies Act (CSA)

Additional CSA rules unclear due to CAMR and CAIR passage

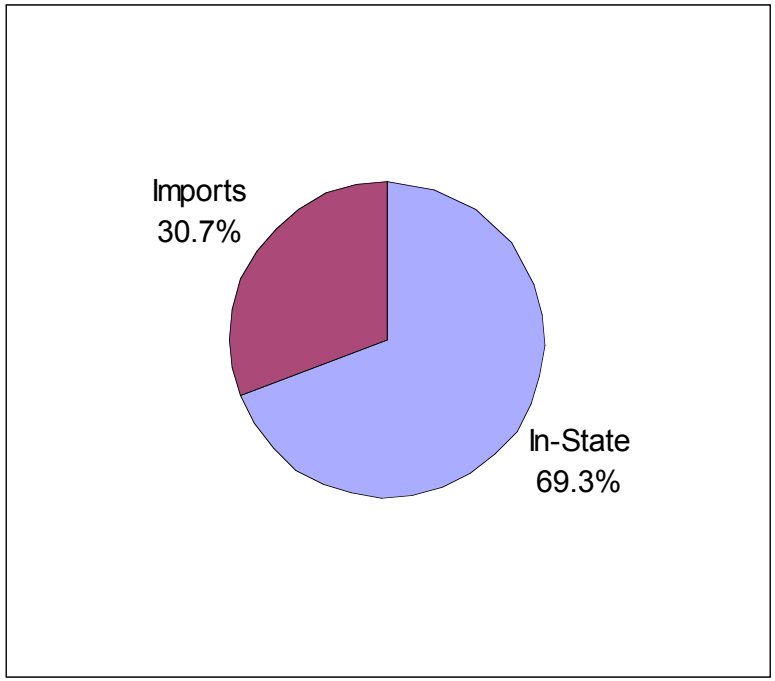
Regional Haze Rule

Regional Haze Plans due December 2007 and will likely include long-term strategies for power plant emission reductions

Import Power Assumptions

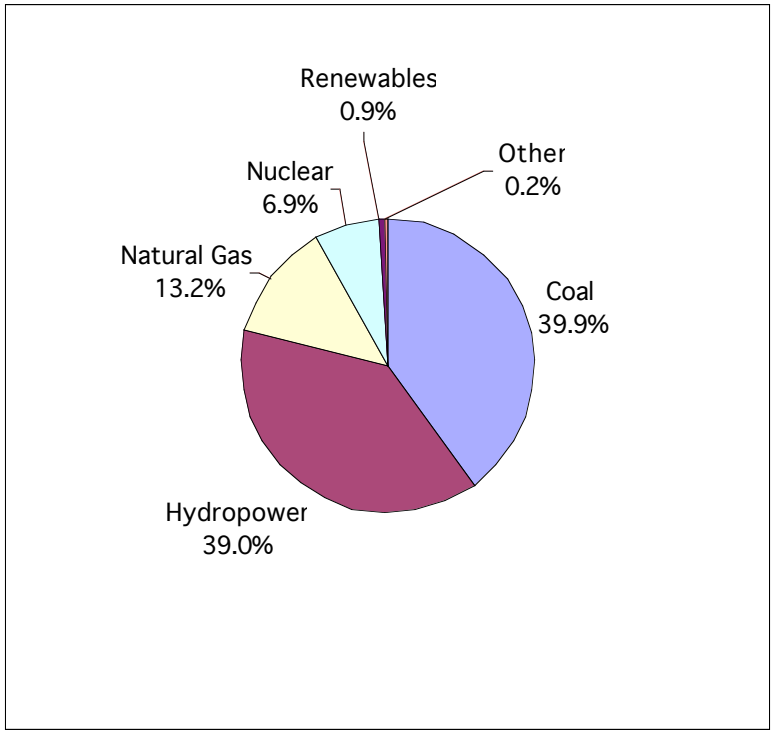
Import Assumptions

1) 2001 – 24.2%
2) 2002 – 31.7%
3) 2003 – 35.6%
4) 2001 though 2003 weighted average is ~31%
5) Power exports not included



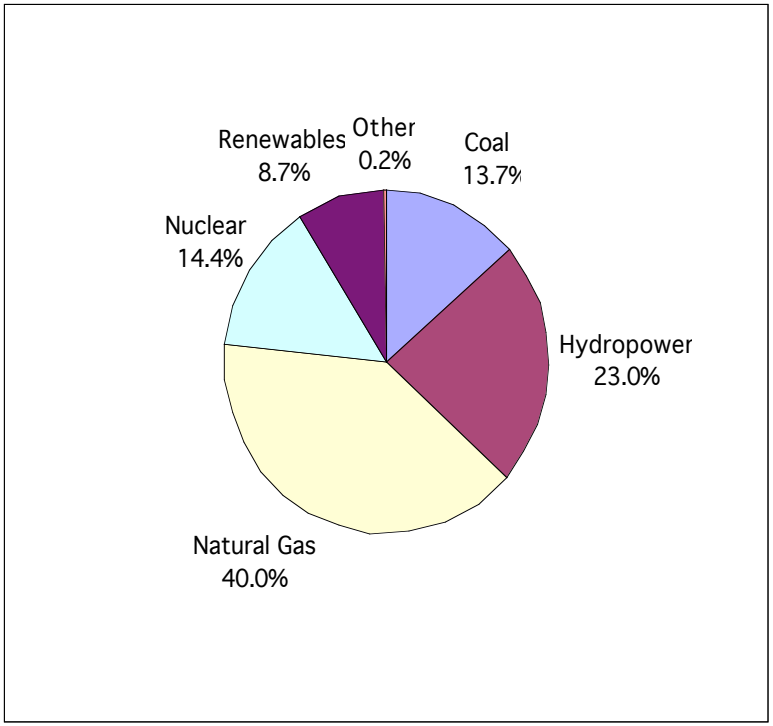
Import Power Assumptions

- Import by power generation technology assumed to be similar to generation percentiles



Instate plus Import Power Totals

- Total in-state plus imported power generation by technology 2001-2003

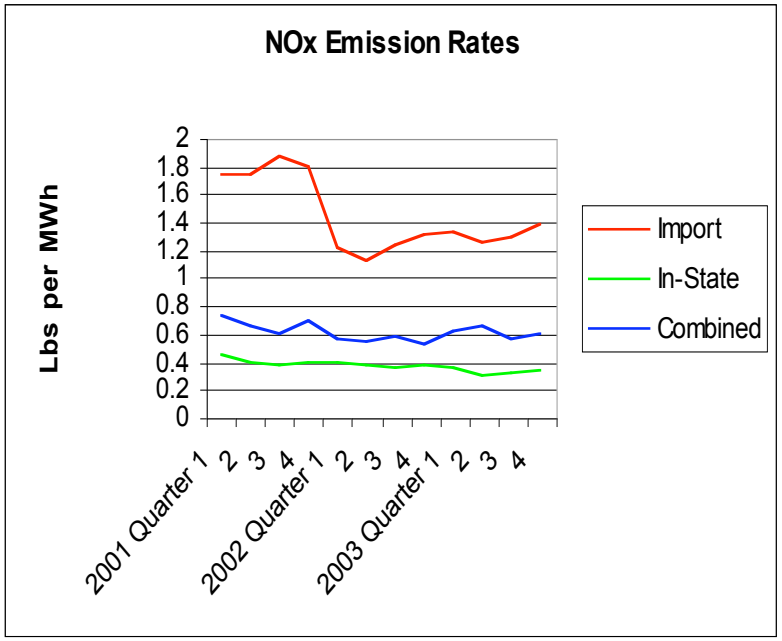


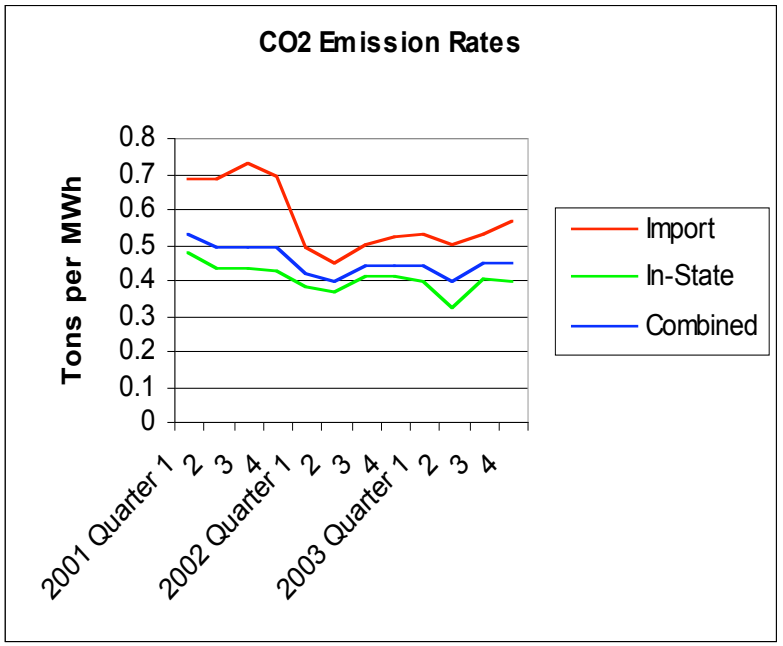
Emissions Comparison

Assumptions/Limitations

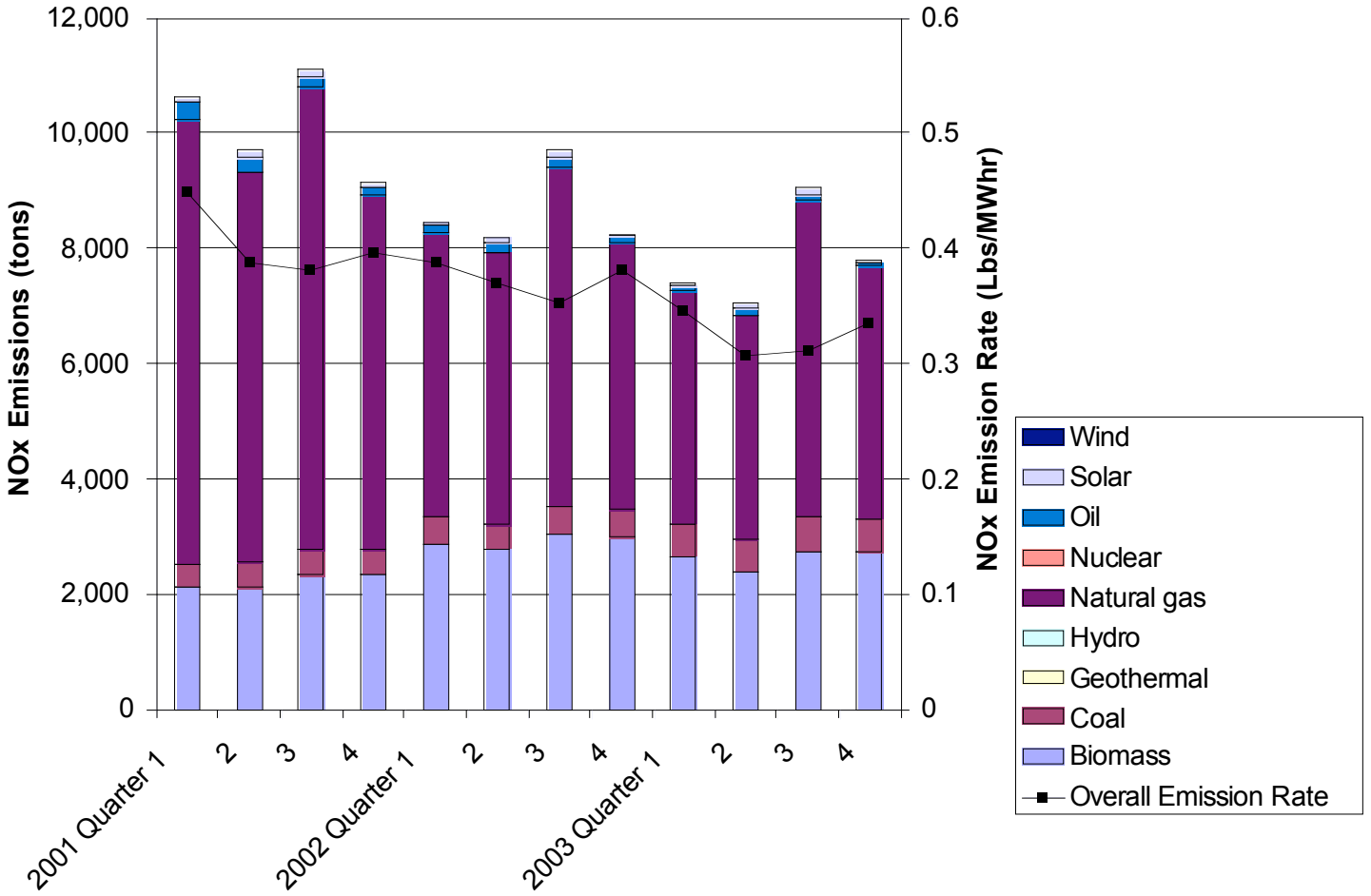
- Simplified western states resource mix
- Simplified western states emission factors
- Specific dedicated coal plant emission factors
- Accuracy would be increased if plant by plant emissions and import contract information were available for all western states imports

Emissions Comparison Summary

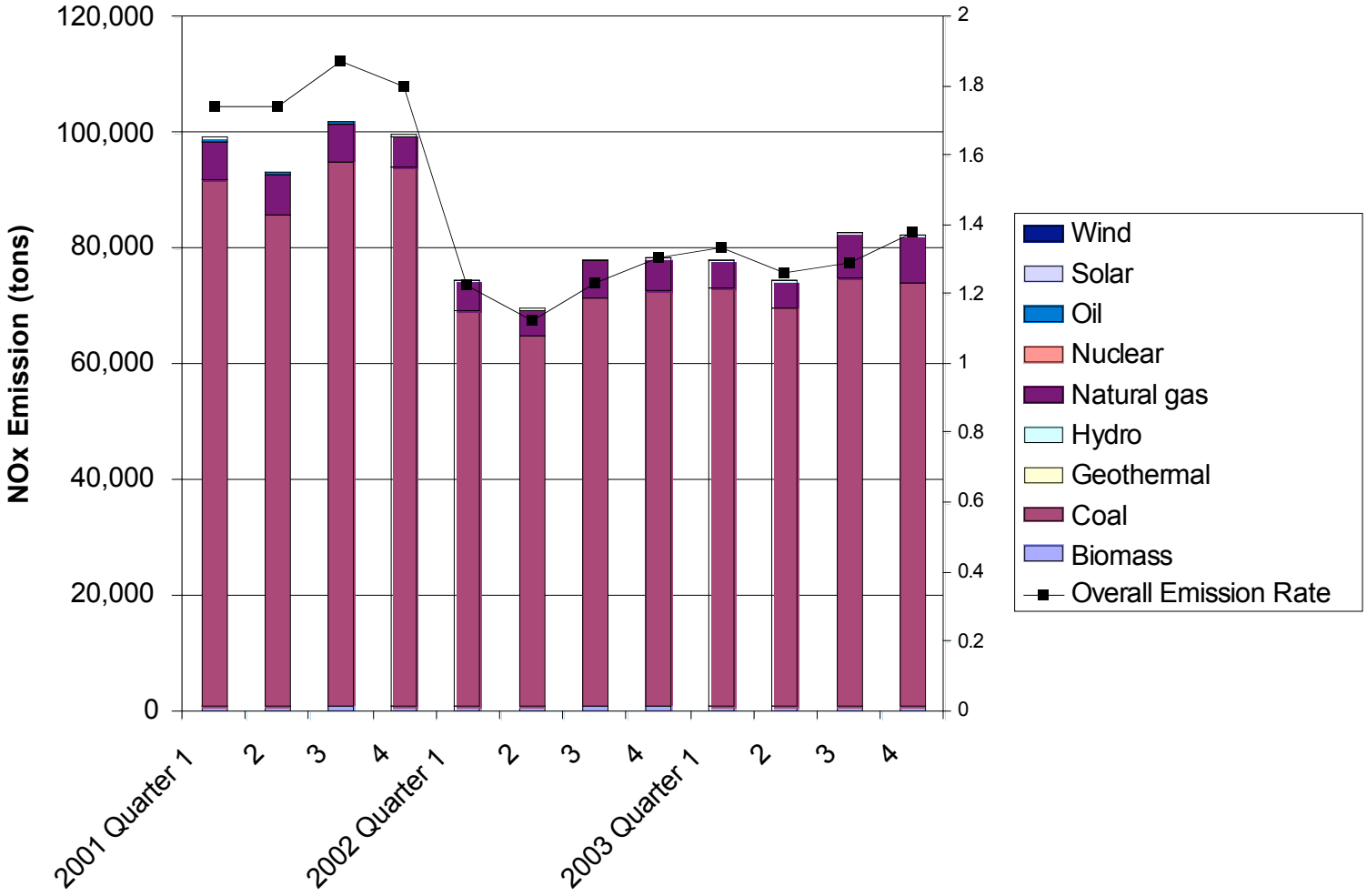




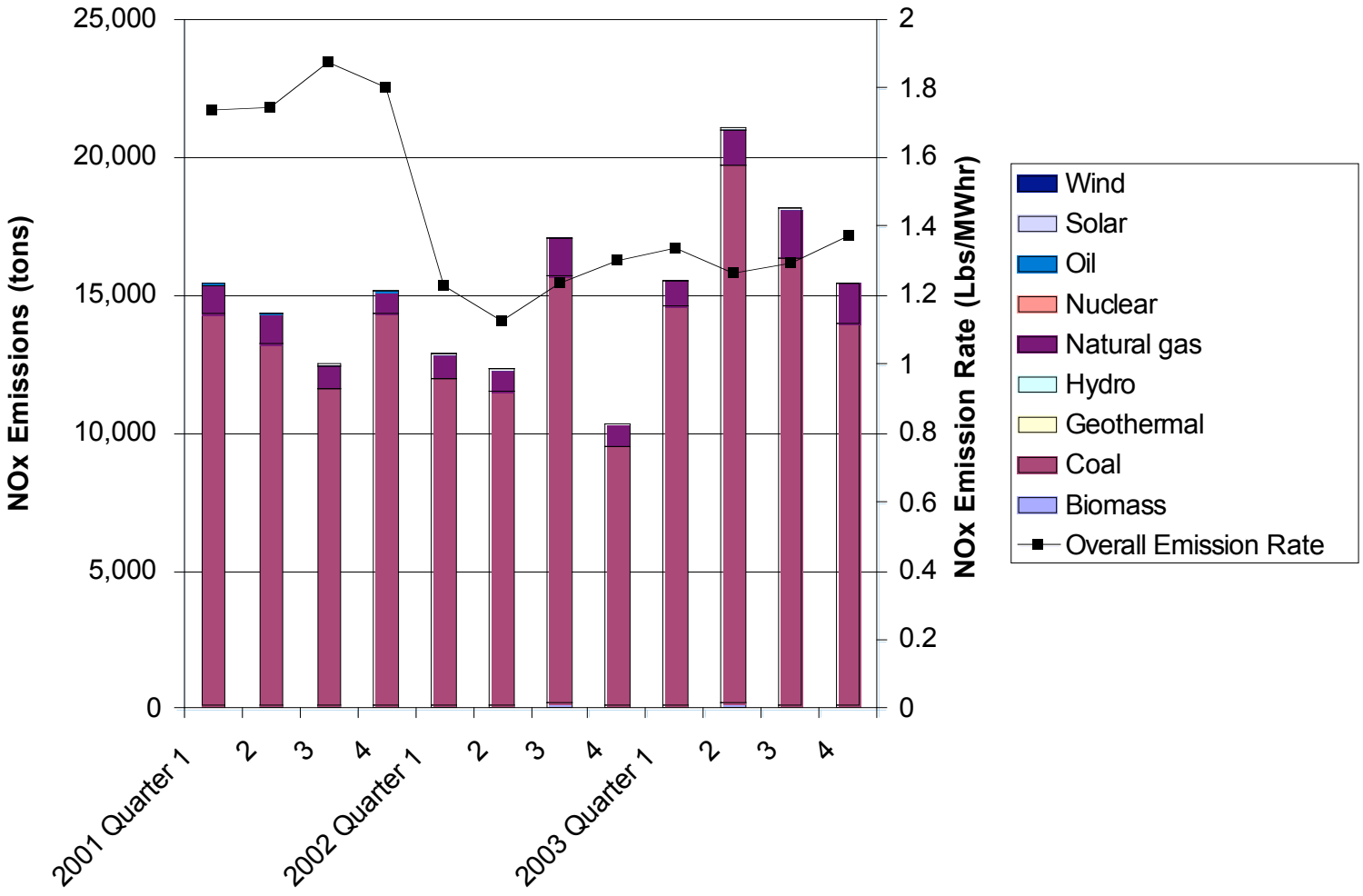
In-State NOx Emissions Totals



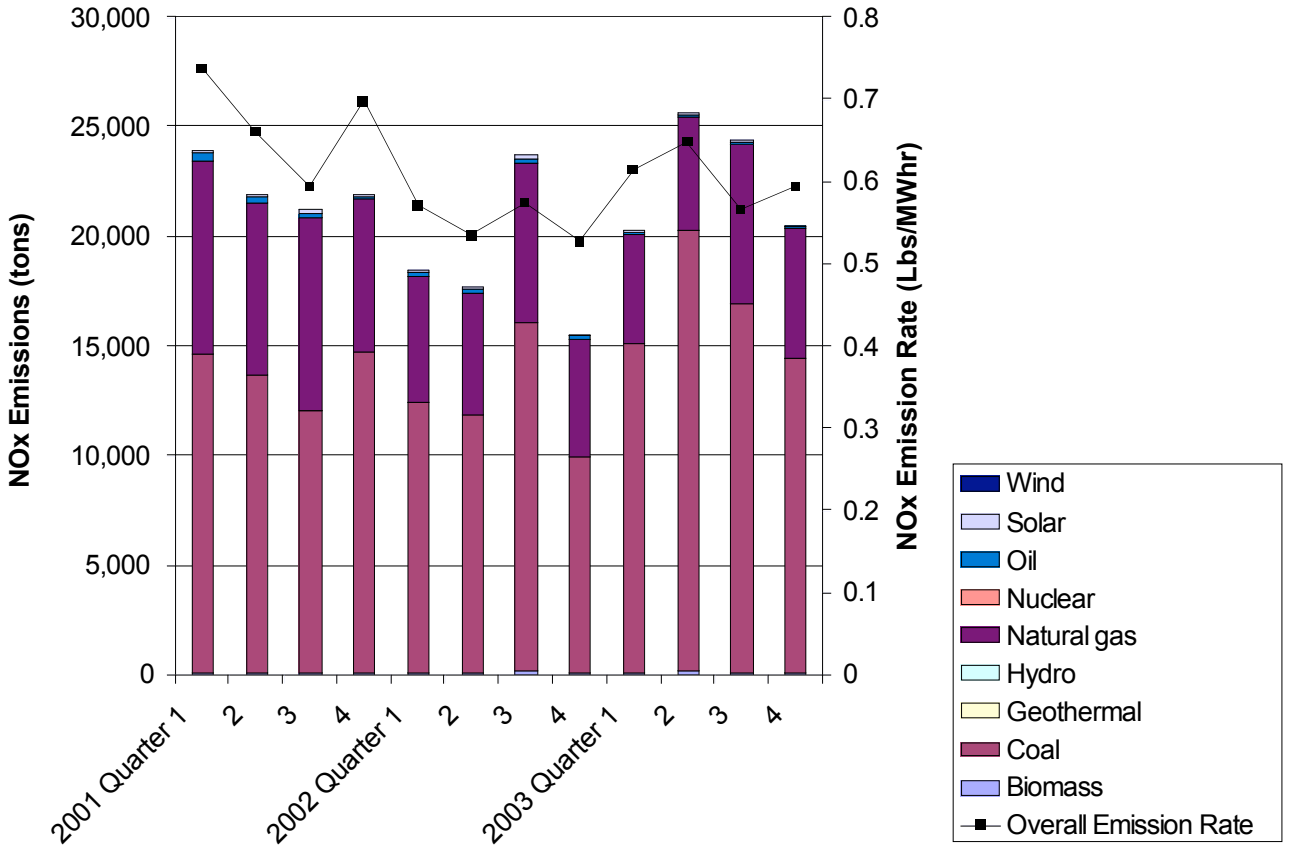
Out of State NOx Emissions Totals



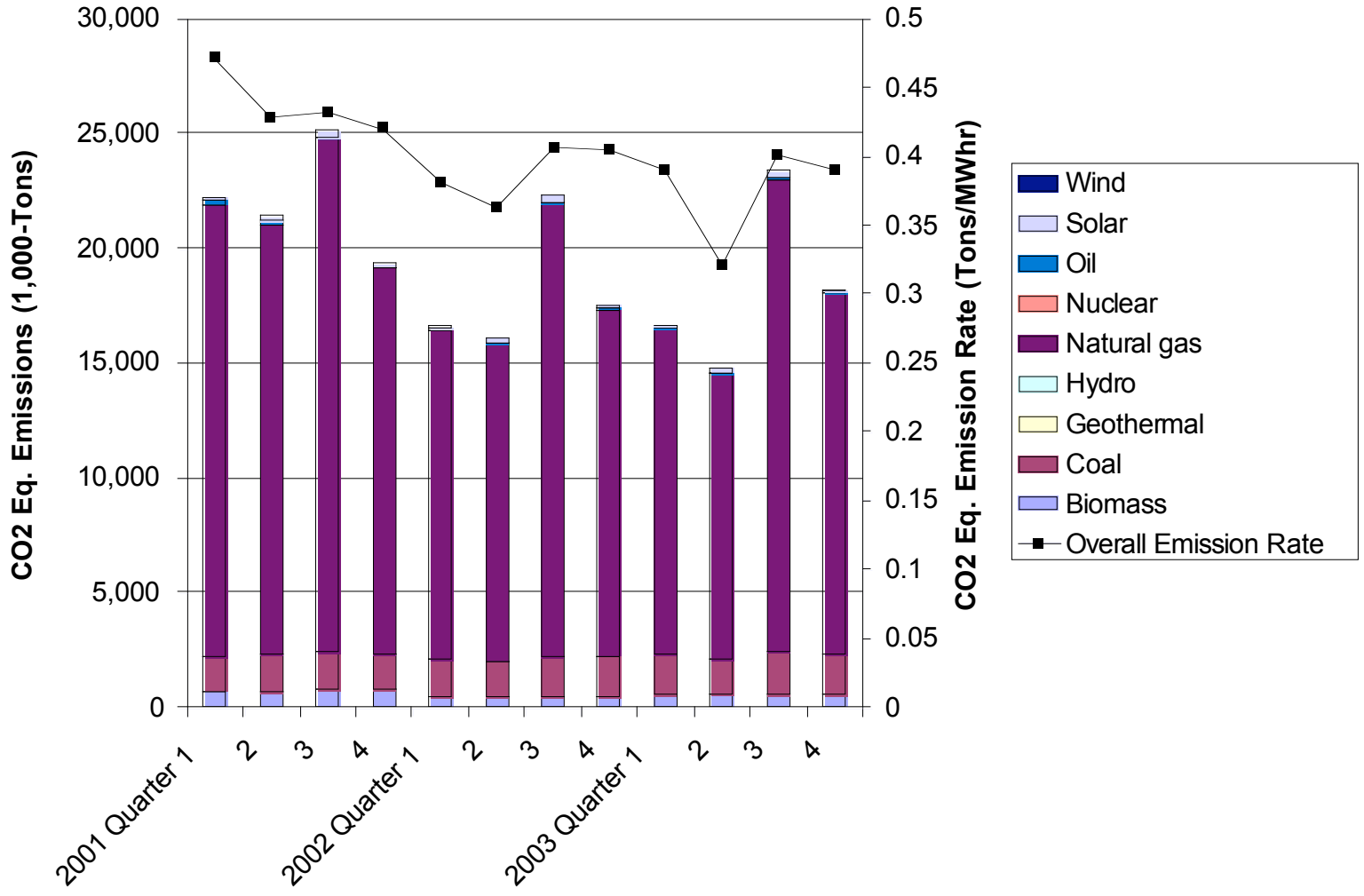
Import NOx Emissions Totals



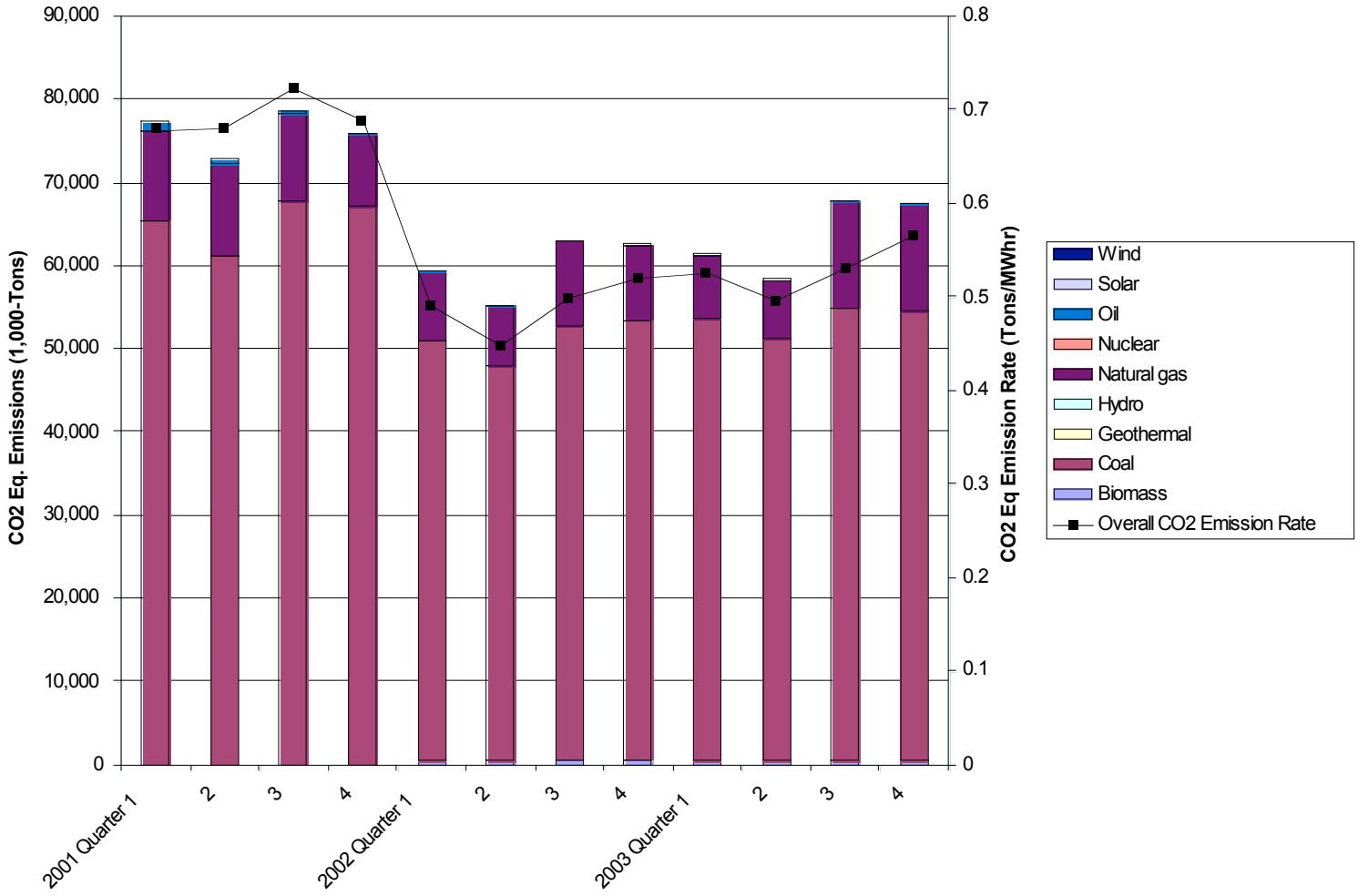
Combined NOx Emissions Totals



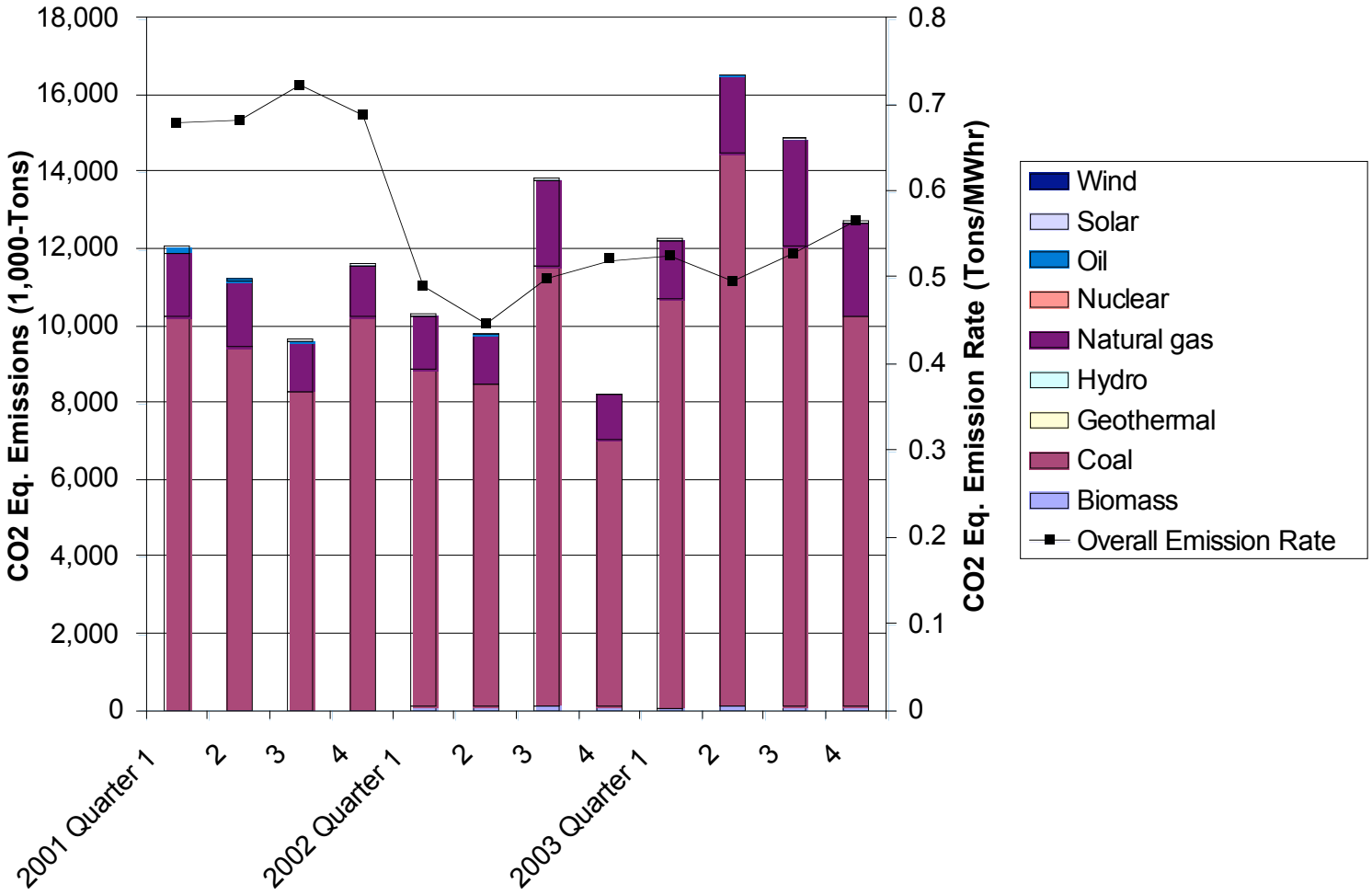
In-State CO_2 Emissions Totals



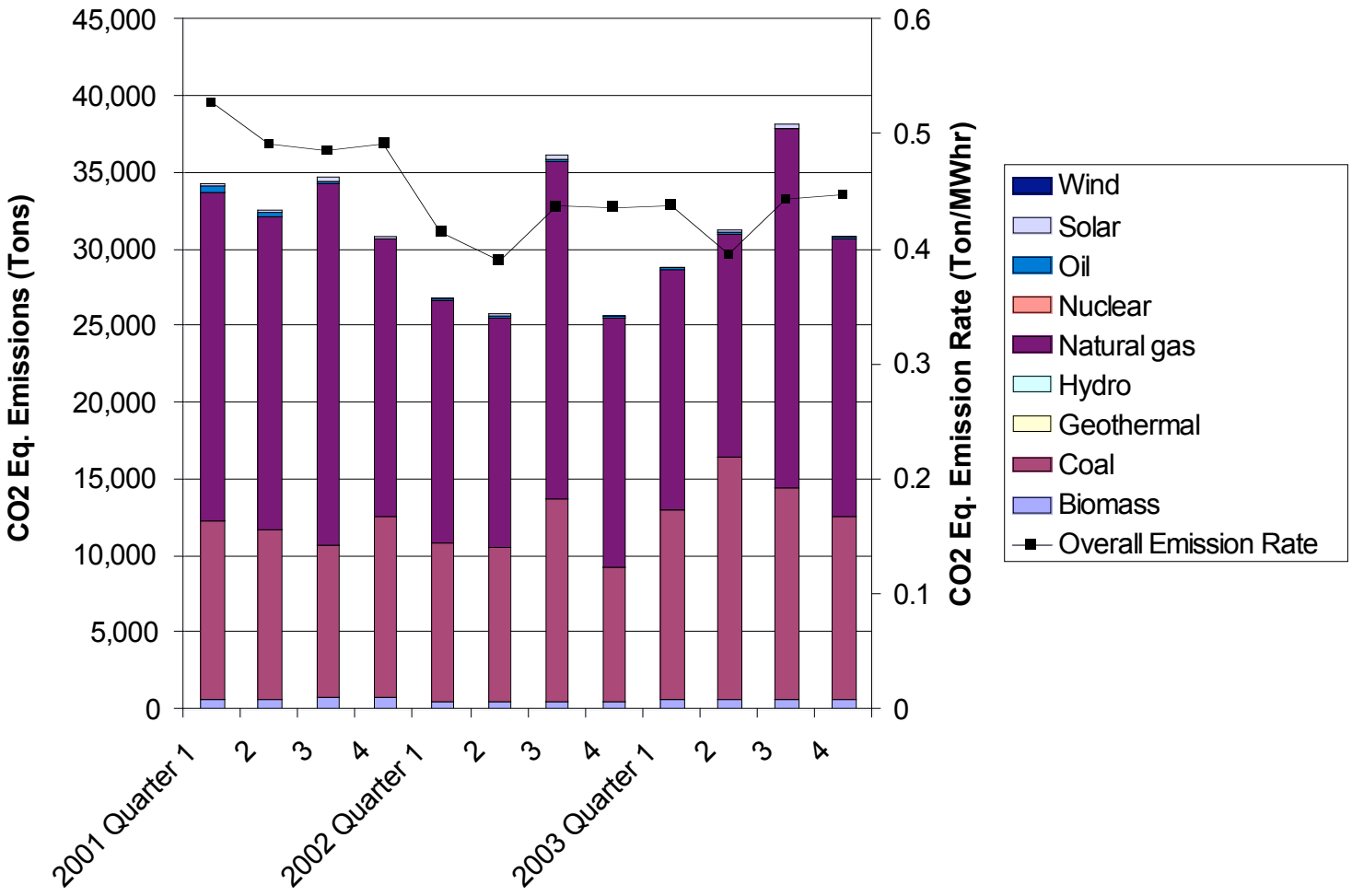
Out of State CO_2 Emissions Totals



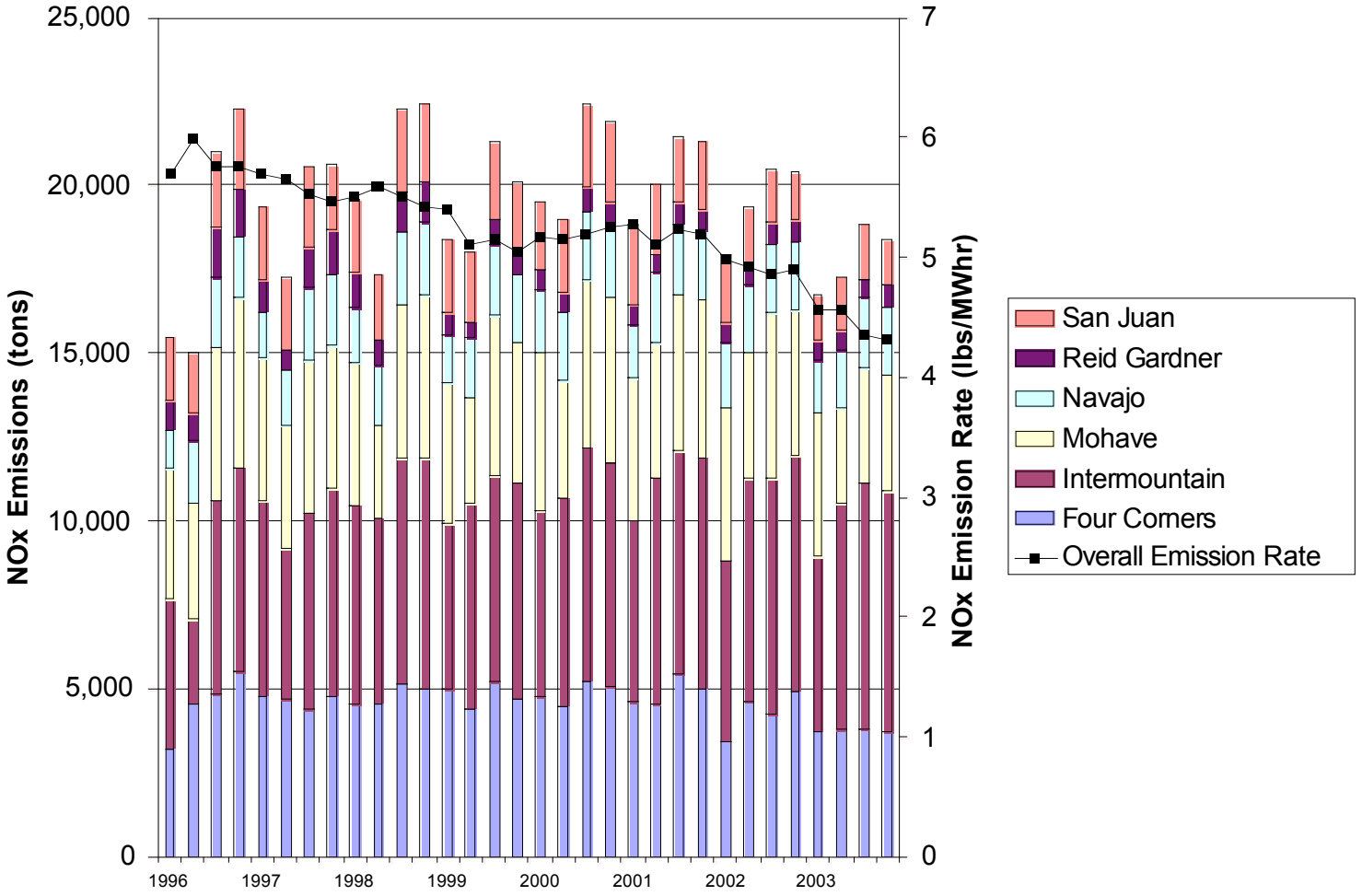
Import CO_2 Emissions Totals



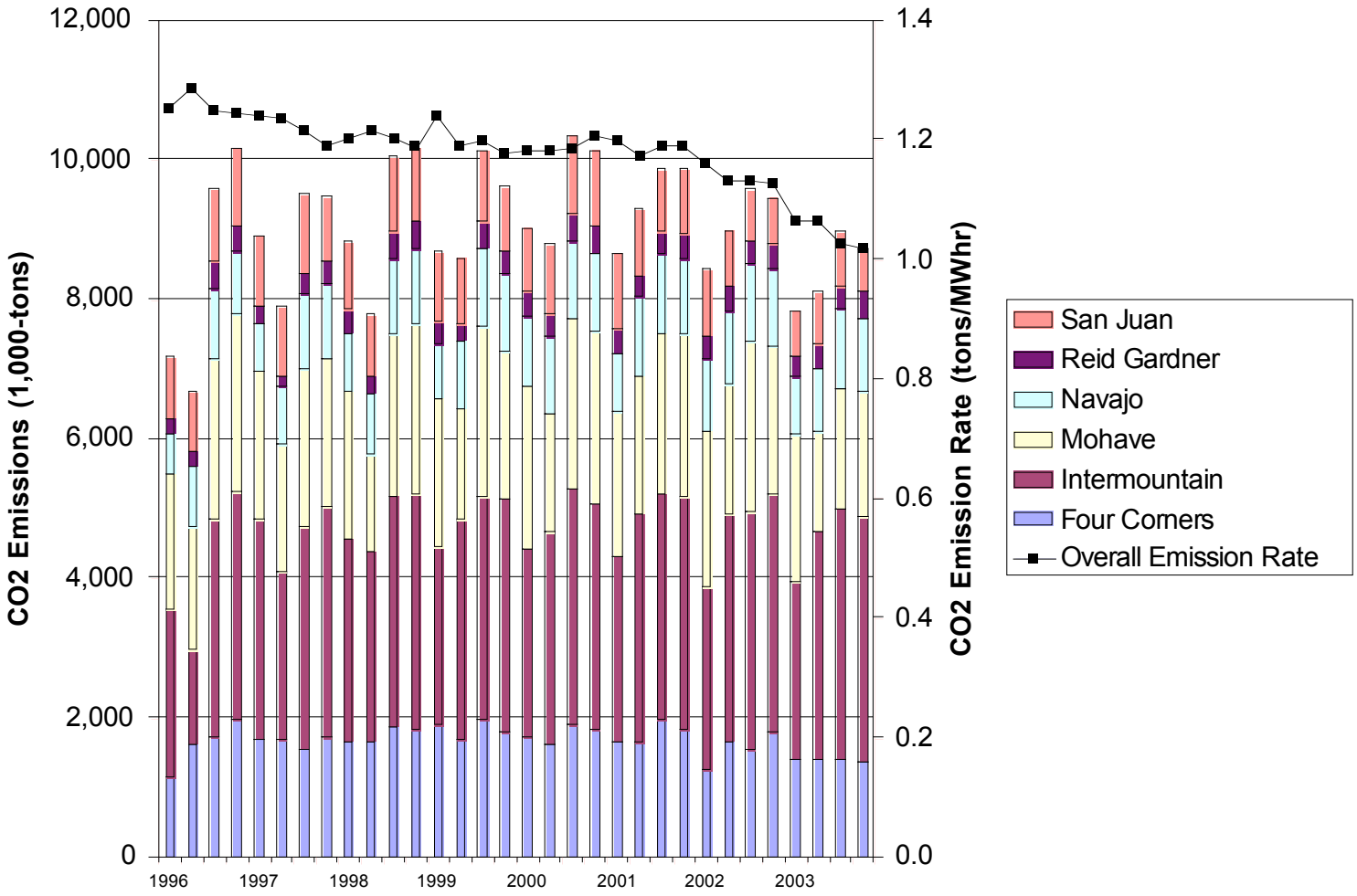
Combined CO_2 Emissions Totals



Dedicated Coal NOx Emissions



Dedicated Coal CO_2 Emissions



Emissions Comparison Summary
(2001-2003 Data)

Western States

Emissions from Imported Power are:

1. **NOx ~ 4 times the in-state average per MWh**
2. **CO_2 ~ 1.4 times the in-state average per MWh**
3. **PM10 ~ 2 times the in-state average per MWh**
4. **SO_2 > 150 times the in-state average per MWh (1999 data)**

Dedicated Coal

Emissions from Dedicated Coal Plant Power are:

1. **NOx ~ 11 times the in-state natural gas fired avg per MWh**
2. **CO_2 ~ 1.7 times the in-state natural gas fired avg per MWh**
3. **PM10 ~ 3.4 times the in-state natural gas fired avg per MWh**

Advanced Technology Emissions

- Gas turbines EFs are based on California required controls
- Baseline PC boiler includes SCR (total NOx control 90%)
- IGCC does not include SCR (inherently cleaner technology)
- Super and Ultrasupercritical boilers include SCR/NSCR; however, control level basis not cited and can be improved
- Circulating pressurized fluid bed combustor does not include SCR